



United States Department of Agriculture - Agricultural Research Service
Food Safety Research Information Office
FSRIO

FOOD SAFETY RESEARCH: A FOCUS ON

Vacuum-Steam-Vacuum Pasteurization

USDA researchers from the Eastern Regional Research Center (ERRC) are currently developing a variation on the traditional surface pasteurization method. Previously, killing bacteria on the surface of foods involved quickly heating the food to a high temperature to kill harmful bacteria. This process was effective in destroying food pathogens, but caused thermal damage and a loss of food quality characteristics such as tenderness in meats and color in fruits and vegetables.

The new method being developed for surface pasteurization of solid foods (poultry, meat, fruit, and vegetables), is called vacuum-steam-vacuum (VSV) pasteurization and is as effective at destroying food pathogens while preserving food quality characteristics. VSV pasteurization shortens the amount of time that food is subjected to heat by removing a thin layer of air and moisture from the surface of foods, allowing the steam to make direct contact with the bacteria, thus reducing the amount of damage to the food surface.

The entire VSV process occurs in less than one second. The first step in the VSV process is the application of a vacuum to remove air and moisture from the surface of the food. In the second step, steam is applied for a short period of time to kill off pathogenic bacteria.



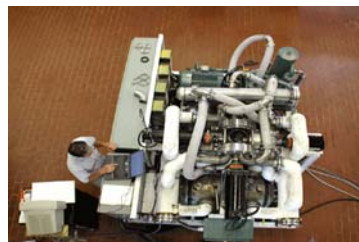
The VSV process has been successfully used to pasteurize poultry.

The final step includes the application of a vacuum to remove condensed steam and to cool the surface to prevent cooking of the food.

In 2001, the vacuum-steam-vacuum process received a U.S. patent, but was tested only on poultry and meat products. Since then, the process has been adapted to effectively treat the surface of citrus fruit (specifically lemons). The current focus is on adapting the process for foods, such as cantaloupes, hot dogs, and vegetables. In addition, researchers are developing the process for emergence into commercial practice.

Since pathogens usually contaminate the surface of solid foods, the VSV pasteurization process effectively kills pathogens commonly responsible for food borne illness, such as Salmonella,

Listeria monocytogenes, Campylobacter, and E. coli 0157:H7. The kill success varies on the foods treated. Chicken, because of the pathogens associated with it, is the most difficult to make safe. Kills range from 90 - 97percent, whereas kills on lemons range from 90 to greater than 99.99 percent.



Surface pasteurization was conceived, tested, publicly patented, and developed by USDA/Agricultural Research Service ERRC.

RESEARCH AREAS

Commercialize the VSV process for other foods including hot dogs and cantaloupes

Develop and optimize the infrared surface heating technology for maximum destruction of Listeria monocytogenes

Measure critical heat transfer parameters such as surface heat transfer coefficients

Develop and test a laboratory-scale unit for validating the effectiveness of the VSV process

Determine the thermal inactivation kinetics of foodborne pathogens at temperatures above 70°C.

Evaluate the effect of different treatment conditions (temperature, time, and vacuum) on the process of surface heat transfer of VSV

Develop an understanding of the fundamental heat transfer phenomenon during VSV processes

Achieve a 99.9 percent kill rate on all poultry products

FSRIO DATABASE PROJECTS

Projects in the FSRI database related to this topic are listed below. Visit FSRI online to access the projects.

Development of Intervention Processes to Enhance the Microbiological Safety of Heat Sensitive Foods

USDA - Agricultural Research Service

Engineered Enzyme-Based Time-Temperature Indicators (TTIs) for Validating Food Pasteurization Processes

USDA - National Research Initiative

In-package pasteurization and food grade film agents for pathogens on meat products

USDA - Cooperative State Research Education and Extension

Post-process Pasteurization of Packaged, Ready-to-eat Meat Products for Control of Listeria monocytogenes

USDA - Cooperative State Research Education and Extension

RESOURCES

This factsheet was produced using the resources listed below. Visit FSRI online to access these links.

Methods and Apparatus for the Treating and Packaging of Raw Meat

ARS- Eastern Regional Research Center

Modification of the VSV Surface Pasteurizer to Treat the Visceral Cavity and Surfaces of Chicken Carcasses

Journal of Food Science

Optimization and Application of the Vacuum/Steam/Vacuum Surface Intervention Process to Fruits and Vegetables

ARS- Eastern Regional Research Center

Post-Processing Interventions to Control Listeriosis

FDA/CFSAN – Office of Plant and Dairy Foods and Beverages

The Poultry Pasteurizer

ARS- Eastern Regional Research Center

Rapid Hot Dog Surface Pasteurization Using Cycles of Vacuum and Steam to Kill Listeria Innocua

USDA- Agricultural Research Service

Steam Pasteurization to Greatly Reduce the Incidence of Pathogens on Beef Carcasses

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

VSV Surface Pasteurization

USDA/ARS/Eastern Regional Research Center



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<http://www.nal.usda.gov/fsrio/research/fsheets.htm>

FSRIO is a unique resource for the food safety research community. The program features a web site that serves as a gateway to research information and includes a database of federally-funded research projects. The database is available for researchers, policymakers, consumers and others to learn about research initiatives, and assist the government in assessing food safety research needs and priorities, thereby minimizing duplication of effort. FSRI also provides a reference service at no charge.

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